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ABSTRACT

Visual literacy literature published during 1965-1975 was surveyed. Entries cited in psychological abstracts, dissertation abstracts, Scientific American, Resources in Education (RIE), and Current Index to Journals in Education (CIJE) were grouped under the following categories: definition, information transmission, advanced organization, attention holding ability, and media construction (the largest category). General trends within each category are discussed. Definitions of visual literacy are considered in the first category, defining a visually literate person as one able to perceive and understand a situation when using pictures of 35mm slides, complemented by either oral or written instruction. Modes of information intake and reproduction and visual/verbal organizers, as they affect learning, are then discussed. The realism theory and related variables are reviewed in the media construction category. Continuum theorists hypothesize that visuals at the realistic end of the spectrum facilitate greater amounts of learning than visuals from other locations on the continuum, bounded at one end by simple abstract "line drawings" and at the other end by photographs of the actual object. This theory was found not to hold since a greater amount of learning was facilitated by simple line abstract drawings. Suggestions for future research related to missing visual literacy links are provided. (Author/JN)

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A SURVEY REVIEW OF VISUAL LITERACY 1965-1975 WITH A SLANT TOWARD SCIENCE EDUCATION

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ABSTRACT

Visual literacy literature during the 1965-1975 period was categorized by definition, information transmission, advanced organization, attention holding ability and media construction. By far the largest literature category was media construction dealing with the human heart. Visual literacy is defined from the literature in the first category. In the second, modes of information intake and reproduction are discussed. Following this, visual and verbal organizers, as they effect learning, are discussed. Attention holding ability of a visual is measured by the number of eye fixations on instructionally important parts. The realism continuum theory and related variables fall under the heading of media construction. The continuum theory was found not to hold; a greater amount of learning was facilitated by simple line abstract drawings. Future researchers should look to the fields of applied technology for possible answers to the missing visual literacy links.

INTRODUCTION

When looking at the literature, we realize "visual literacy" has several definitions. It depends on who the definers are, their academic backgrounds and where their research and professional interests lie. In its' most general sense, visual literacy is defined as, "the ability to read and write using visuals." For our purposes, the definition is far too broad. The following definition evolved from an attempt to delimit the general definitions. A visually literate person is one able to perceive and understand a situation when using pictures of 35mm slides, complemented by either oral or written instruction.

The survey includes literature published between 1965 to 1975. In searching literature for review possibilities entrees cited in psychological abstracts, dissertation abstracts, Scientific American, ERIC, and CIJE were considered.

The literature fell into the following general categories; definition, information transmission, advanced organization, attention holding ability, media construction. In surveying the literature for categorical inclusions those studies, in which authors failed to proceed with logical consistency, were rejected. The categorical discussion which follows centers on the general trends of the literature in that category and does not necessarily include a mention of every study found to fall in that category. Every paper which was surveyed for inclusion; however, can be found in the bibliographical listing at the end of the paper.

DEFINITION

Visual literacy has from time-to-time been defined in a variety of ways. Harris (1967) points out that in the 18th century investigators discussed the idea that since images were produced in an inverted form on the retina, people must learn to see. Another prevalent idea of the 18th century was that vision was educated by thought and touch. Debes (1969) states that visual literacy as a concept, gained its foothold in the 1930s and by the 1960s the view that what we see is only a symbol and not reality had become established.

Visual literates have been identified by types such as normal visual and haptic and they have been categorized as more or less visually literate based on a heirarchy of visual cues to which they are able to react. It appears that becoming a visually literate person is a sequential process terminating when a person can be identified as a particular type and is able to adequately perform all of the process steps that are sufficient criteria for a type assignment. From this it is inferred that to be visually literate, a person must be able to react correctly to all of the cues listed in the heirarchy and visual literacy can be defined as those skills a person must possess in order to be typed.

The visual heirarchy (Debes 1969, Debes & Williams 1974) probably begins when one is first able to distinguish light from dark and proceeds through the following steps; being able to distinguish between differences in brightness, shape and size; being able to perceive height and depth, grouping and sequencing, and; being able to read body language. A person reaches the zenith of the heirarchy when he or she is able to read a sequence of objects or body language and compile some expression describing the sequence in a way that others understand. Two characteristics of a visually literate person,

implied in the foregoing discussion are important to this writing. First, visually literate people know the grammar and syntax of visual language and are able to apply them. Finally, visually literate people are familiar with the tools of visual literacy and how to use them.

Ausburn (F.B., 1975) discussed two visual perceptual types, the normal visual and the haptic. The normal visual is a person who perceives visual detail easily and mentally retains visual images. The haptic person is one who has difficulty perceiving visual detail and who also has difficulty maintaining mental images. Ausburn (L.J., 1975) states that the visual people rely on vision as their major sensory intermediary while haptics rely on kinesthetic impressions as their primary mode of sensory input. For haptics there are at least two different information transmission modes and in the case of haptics, (who are of normal visual acuity) visual information transmission is aided and supported by various kinesthetic tactile stimuli.

INFORMATION TRANSMISSION

The Homo sapiens sapiens takes in information from the external environment via the five senses. Blocking four senses while measuring the ability of the fifth to transmit information is all but impossible. Any discussion of information acquisition and transmission, therefore, can occur only after acknowledging that while one sense is probably the primary acquisition agent of facts it is not wholly responsible for the total result (Hsia, 1968). In reality there probably is an optimum level of information input from all sensory sources per unit of acquired knowledge, and the percentile use relationship between information acquisition channels may determine the amount of knowledge acquired per unit time.

Boyd and George (1973) studied the relationship between abstract categorization behavior of students aged 10 to 13 years and hearing losses of from 60-80 db. They found the experimental group, which was allowed to develop hierarchical categorization skills prior to the posttest, performed significantly better on the posttest than the control group students who received only pre- and posttesting. This fact suggests that kinesthetic tactile stimuli aid visual learning. At this point it might be questioned whether sensory motor perception aids visual perception or the converse.

Harris and Rock (1967) found vision to take precedence over touch. In their experiment subjects (Ss) examined objects through reducing lenses while handling the same objects with their hands. During the treatment, the Ss hands and arms were covered with cloth so that object size and hand size could not be compared. They were then asked to approximate the size of the objects by drawing an object's size and by choosing an object of the same size seen from among a group of objects graded by size. The subjects consistently drew and chose objects whose size approximated that of the object seen through the reducing lens. Harris and Rock (1967) also had Ss view objects through an optical device which caused cubes to appear as rectangular solids, while the objects were handled as mentioned above. The subjects reported that the objects felt as they appeared through the optics; however, when Ss closed their eyes they reported they thought they felt the objects changing shape. In a third experiment, with Ss wearing prism goggles which shifted the visual field 11° left and right, the investigators were able to visually condition Ss pointing arms through pointing exercises, so that when Ss removed their goggles they would, then pointing, consistently direct the conditioned arm 11° to one side of the object at which they were pointing.

When information is acquired visually or orally it is processed and either stored for future recall or reused immediately. If information is needed for reuse it can be reproduced orally or by writing or drawing. Consequently, there are four possible acquisition-reproduction modes. The efficiency and fidelity of any one mode is probably dependent upon the number of cerebral information transformations which must take place, for the mode, prior to reproduction. Randhawa (1971) studied visual and audio modes of information input and unioned them with the written and verbal modes of output. He found, with regard to apprehension span, the following hierarchy to hold true among three different age groups (the first mode had the greatest span, etc.): (1) visual input - written output; (2) audio input - written output; (3) visual input - verbal output; (4) audio input - verbal output. In addition, the difference between written and verbal outputs decreased with age. He also found apprehension spans to increase with age regardless of the input and output modes. As a result the author suggested since, audio input - written output was superior to visual input - verbal output, the visual input - written output mode probably required no cerebral modality transformations while the audio input - verbal output mode required two.

ADVANCED ORGANIZATION

The objective step is one of several normally included in lesson planning. It gives both students and instructors an idea of the types of behaviors student should manifest as a result of having experienced a lesson. This step is intended not only to give students an idea of a lesson's outcome but also to organize the lesson for them. In this regard,

researchers feel that if students have an idea of how an integrated whole is organized they will better be able to understand individual steps within a lesson.

An overview of this nature is possible regardless of the instructional media used. If verbal instruction is complimented by visual instruction, the tendency is to use verbal advanced organization techniques; however, if visual instruction is complimented by verbal instruction it probably is more effective to use a visual advanced organizer. Visual organizers should provide overviews of more detailed information to follow and provide organizing elements that take the content into account.

When considering the use of a visual organizer, the first question we ponder is whether more learning is facilitated when they are used than when they are not used, and second, whether they are more effective than verbal organizers. Weisberg (1970), investigated the relative effectiveness of verbal descriptions, maps, and graphs as advanced organizers. Post-hoc comparisons of mean differences in posttest scores showed the greatest difference to exist between those who received the map organizer and the control group (control= no organizer). The graph-control group mean difference was nearly the same as map-control; however, the verbal organizer (descriptions) did not contribute significantly to new learning. The findings of this study are of special interest to designers of audio-tutorial courses in which visuals are used since a choice must be made regarding the type of organizer to be used.

ATTENTION HOLDING ABILITY

If something is to be classified as a visual cue or stimulus it must have some degree of attention attraction. The magnitude and duration of

attraction strength is, no doubt, proportional to the magnitude of cue strength and cue strength may depend upon cue class. There are at least three classes of cues used in visual construction; (1) the amount of detail contained in visuals; (2) the use of color or black and white visuals, and; the use of positive or negative backgrounds. Category one is a continuum with abstract simple line drawings of an object at one antipode to actual photographs of that object at the other (sometimes called the realism continuum). If we ask what color to use on visuals in cue category one if a visual is to have the greatest possible success in holding students' attention an almost unlimited number of possible answers exist.

The realism continuum, has been subdivided by investigators in the following manner. The subcategories are; (1) abstract simple line drawings; (2) detailed shaded drawings; (3) photographs of a model of an object; and, photographs of an actual object (Dwyer, 1966).

Viewing strategies depend upon the type of material to be viewed. Strategy for example, is not the same when viewing visuals of printed matter, as it is when viewing simple line drawings. Measurement of viewing strategies followed by comparison of strategies to posttest results on criterion measures provides an idea of the effectiveness of various types of visual composition. If two classes of visual cues, for example, are compared to determine relative effectiveness, attention spans illicited by each class could be evaluated. Such comparisons can be made using each class posttest results on criterion measures. Strong positive correlations between posttest results and attention span and significant differences between class posttest results make it possible to predict outcomes on criterion measures for a class of visual cues (based on students' attention spans). Thus it becomes possible to postulate regarding the use of one visual type or another.

Techniques used when measuring attention span have been adopted from those used for diagnosis of reading difficulties. In reading clinics, diagnosticians often use photographic techniques to measure the numbers of eye fixations per word and per line as a predictor of reading rate. The amount of attention paid a word or sentence is negatively correlated with reading rate. Rusk (1971) studied eye movements and numbers of fixations of subjects as they viewed slides of black and white photographs and line drawings of a television camera control section, in which the important controls were highlighted by arrows. In the experimental treatment, subjects were allowed two different viewing times. After the viewing, Rusk analyzed number of Ss eye movements and fixations on instructionally important parts of the TV camera. He found; (1) a lack of significant differences between attention to instructionally important objects resulting from varying amounts of detail and varied amounts of viewing time; (2) a lack of significant differences in performance on criterion measures resulting from varied amounts of detail being viewed for varying amounts of time; (3) a lack of significant differences on criterion measures for Ss who dealt with pictorial illustrations varying in amount of realistic detail, and criterion performance of Ss who dealt with the actual items.

In an investigation similar to Rusk's (1971), Caban (1972) investigated the use of color. Colored pictures were found more effective than black and white pictures. In addition, he found a significant aptitude test interaction between eye fixations and success with color and black and white pictures.

MEDIA CONSTRUCTION

By far, the largest number of studies conducted between 1965 and 1975 fell into the media construction category. They were subcategorized in the following manner; studies where visual media were transparencies presented using overhead project techniques, studies where 2"x2" or 35mm slides were used and; studies where a visually complimented programmed text was used. The unifying factor across these studies was that each dealt with the ability of the visuals to facilitate achievement (understanding). Some investigators used specific criterion measures to rest the relative worth of the visual construction types used, suggesting that their studies were specific educational objective oriented. Other studies included I.Q., time, and sex variables with the visual variables.

The realism continuum was briefly mentioned in the previous section. Continuum theorists hypothesized with regard to visual media construction, that visuals at the realistic end of the spectrum facilitated greater amounts of learning than visuals from other locations on the continuum. The continuum is bounded at one end by abstract simple line drawings and at the other end by photographs of the actual object. Categories most commonly used in studies were abstract simple "line drawings, detailed shaded drawings, photographs of models of an actual object and photographs of an actual object (the object was constant across categories). The color was also used in some studies leading to evaluation of visual media construction types; (1) simple line drawings in black and white; (2) simple line drawings in color; (3) detailed shaded drawings in black and white; (4) detailed shaded color drawings; (5) realistic black and white models; (6) realistic colored models; (7) actual objects in black and white, and (8) actual colored objects. Control groups in studies evaluating the continuum, usually viewed slides containing only words of the instructionally important parts of an

object while experimental group were shown different types of slides of the actual object. In another approach, controls received only the audio compliments of the audio-visual presentation given treatment groups. Positive and negative slide backgrounds, also were investigated. The relative effectiveness of the realism continuum variables; however, were not used in this study.

Generally, regardless of the objects used as the focus for construction of visuals, simple line drawings, detailed shaded drawings model, photographs and actual object photographs were themselves photographed on 35mm film and mounted as transparencies for use with a standard slide projector. Slide presentations were complimented by audio presentations, often in the form of tape recordings. Audio tapes were cued (each subject had the same amount of viewing time regardless of treatment group) and the slides advanced by someone not participating in the study.

Some investigators administered a pretest prior to conducting an experimental treatment so that subject backgrounds, at the time of entry, could be evaluated. Other researchers examined immediate verses delayed retention with delayed retention usually measured two weeks after the experimental treatment.

Pearce (1971), using overhead transparencies constructed as; (1) color image-positive background; (2) color image-negative background, (3) black and white image-positive background; (4) Black and white image-negative background, found (with viewing and oral presentation constant) more learning facilitated by noncolor than color images. He, in addition, found positive backgrounds to facilitate more achievement than negative backgrounds.

The relative effectiveness of various sized visuals in facilitating learning was also examined. (Moore 1970) found among three different age groups, that medium sized visuals produced the greatest amount of immediate recall while the smallest visuals were least effective. Metcalf (1968), using 2" x 2" slides, found that as the amount of light in a viewing room increased projection size had to be increased if adequate results were to be obtained. He (Metcalf, 1968) also found best results obtained from high contrast visuals.

Dwyer (1966) developed the scheme for evaluating the relative effectiveness of visuals in various construction categories of the realism continuum found in many contemporary investigations. In his approach, he used sets of 35mm slides complimented by sound cued audio tapes. The slides contained information considered instructionally important to the subject being studied. In his studies Dwyer always used the human heart and, immediately following a treatment administered posttests covering terminology, comprehension, drawing, and part identification. In some studies, he used a total criterion measure posttest (a summation of the scores of the four posttests) as well as pre- and delayed retention tests, to evaluate visual effectiveness. Dwyer also used the number of visual construction schemes (realism continuum) as the independent variable. Dwyer (1965; 1968a, 1969b) and Wheelbarger (1970) found the realism continuum not to be an adequate predictor of criterion measure achievement. In his (1969a, 1969b, 1971) studies Dwyer found simple line drawings to be more effective than other more complex visuals and a lack of significant differences in learning to exist between sexes using the same visuals. Dwyer (1970, 1971) found, for specific learning objectives, the addition of color (to certain types of visuals, e.g. simple line drawings)

appeared to be important in improving subject achievement. His hypothesis here was that certain types of visuals are better able to facilitate achievement with regard to some types of educational objectives than they are with others. In his 1971 study, simple line black and white drawings were the most effective facilitators of achievement on the drawing test, simple colored line drawings were most effective with the total criterion test and detailed shaded colored drawings most effective with the item identification test. In this study (Dwyer, 1971) the control group received only oral instruction. The oral presentation facilitated the greatest achievement on the terminology and comprehension tests, suggesting that visuals may confound learning gain in these areas.

Isaacs (1969) evaluated the effect of color coding on the time required for subjects to reach criterion level. He found, even when subjects were alerted to color coding by verbal instructions, the added color was not beneficial in reducing the number of trials required to learn instructionally important material. Lambertski (1975), using a modification of Dwyer's (1966) methods and colored and black and white arrows to cue instructionally important portions of objects shown on slides, found immediate posttests results favored black and white cueing while a two week delayed retention test showed a lack of significant differences between cueing types.

Arnold (1973), applying Dwyer's (1966) model to programmed instruction found significant relationships between subjects' entry behaviors and achievement on posttest criterion measures. Dwyer (1968b), applying his effective means of facilitating achievement on the terminology and comprehension tests. In another study, Dwyer (1969b) found, when viewing time was not held constant, the realistic photograph facilitated the greatest

amount of achievement on the drawing, identification and total criterion measure tests. In still another study, Dwyer (1972) found blue simple line drawings on a pink background to be the most effective method of facilitating understanding on drawing and total criterion measure tests (both Dwyer's 1969b and 1972 studies used the programmed text format).

When comparing I.Q. and achievement facilitated by different visual construction types (visuals complimented by audio instruction) Dwyer (1975) and Parkhurst (1975) found that all types were not equally effective in facilitating achievement on all educational objectives. There were I.Q. visual type, objective, achievement interactions.

CONCLUSIONS

The literature did not yield studies completely indicative of the visual literacy definition presented to the Introduction. There is a need to investigate the relationship between visual construction and audio/video ratios within educational programs incorporating kinesthetic-tactile variables (laboratory experiments). Such data may help audio-tutorial program designers construct better programs. While it seems possible to piece together a visual construction scheme (complemented by audio instructions) which may yield optimum results on a given educational objective it is impossible to ascertain what the best construction type is when kinesthetic and tactile variables are added. Studies of the type discussed in this paragraph may have been conducted in areas peripheral to science education. Investigators should search these areas before developing experimental designs to answer the questions discussed here.

If Arnold's (1973) work were carried further, it might eventually be possible to assign incoming students to course treatments which best facilitate

learning for a given set of behavioral characteristics.

Conflicting results appear to have been obtained in Dwyer's (1968b, 1969b, 1972) studies. There may be a need to analyze and possibly rerun these studies before applying results to new programmed format construction.

What the best type of visual construction or the best visual to other media ratio is for a given educational objective, is as yet an unknown quantity. The answers to these questions lie in further extensive and meticulous research. Seasoned as well as freshman visual literacy researchers should develop dialogues with researchers in fields other than educational media before they attempt to answer the myriad of questions. It is conceivable, for example, that some of the necessary ground work has already been completed by people in the applied technology fields who are not even aware of the visual literacy field.

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